

## C = The Factor for Cover and Management

There are 10 RUSLE "C" & "K" factor zones in Kansas as shown in Figure K-1. Each zone is represented by the climatic database for a selected city. Those cities are Ness City, Norton, Concordia, Manhattan, Coldwater, Wellington, Chanute in Kansas; Springfield and Burlington in Colorado; and Shenandoah, Iowa. "C" factor tables have been generated for each of these zones except 82T and 83T-B. "C" factors developed in Zone 88A will be used for Zone 82T and "C" factors developed for Zone 88B will be used for Zone 83T-B until values are developed that are consistent with adjoining states.

The "C" factor tables are constructed for the user to choose the "C" factor for the crop being planted and evaluate the impact of the previous crop in the rotation considering the tillage system being used.

"C" factors are shown in Table C-6. These pages are a family of tables and graphs that display values by the crop to be planted and the preceding crop. "C" factors are displayed by tillage type for several levels of residue cover after planting at an average yield level. Yield information is presented in Table C-1.

Each "C" factor zone has a corresponding table (Table C-1) and is based upon the listed yield levels. These yield levels represent a medium or average yield for the "C" factor area.

"C" factor tables contained in the Kansas FOTG are relevant to each individual "C" factor zone throughout Kansas. Table C-1 will change from zone to zone depending on the climatic station used to generate the table.

The residue cover value necessary for "C" factor development can be determined by estimating residue production and reduction for planning purposes or precisely measured in the field. Tables C-2, C-3, and C-4 can be used to estimate residue quantities for planning purposes. Average crop yields and the corresponding residue value from Table

C-2 can be used to determine initial residue production at harvest. Estimations of residue reduction can be determined with Table C-3. The values in Table C-6 were developed jointly by NRCS and the Equipment Manufacturers Institute in February 1992.

Table C-4 is used to convert pounds of residue to percent surface cover.

Each tillage or planting operation leaves a percent of the residue that was present just prior to that operation. The numbers in Table C-3 represent the remaining percentages.

The values in Table C-3 should only be used as a guide in conservation planning. Residue amounts left by each operation should be measured in the field to make necessary adjustments to table values.

Crop residue has been generally classified as being either nonfragile or fragile in Table C-5. This is a subjective classification based in part on the ease in which crop residues are decomposed by the elements or buried by tillage operations. Plant characteristics such as composition, size of leaf stems, density, and relative quantities of the residue produced were considered.

Many factors affect the amount of residue left after a pass with a tractor and tillage or planting equipment. Residue levels are sensitive to depth, speed of equipment operation, and row spacing. When selecting values from Table C-3 for a specific machine, consider the following general rules of thumb:

Shallower operating depths leave greater amounts of residue on the surface while deeper operating depths bury more residue.

Slower operating speeds leave more residue on the surface while faster speeds bury more residue. Under some conditions, field cultivators, finishing tools with field cultivator gangs, and some planters and drills may return as much

as 20 percent of the residue incorporated by previous operations.

- Excess wheel slippage caused by improper ballasting of tractor tires can destroy valuable residue in the wheel tracks. Higher retention values should be used when dealing with residue in excess of 2000 pounds, and the lower values should be used when residue amounts are less than 2000 pounds.

- Convert the calculated residue value to percent residue cover using Table C-4.
- Using Tables C-3 and C-5 determine the residue value for the period of interest in percent residue cover.

Crop rotation "C" factors can be constructed by selecting the appropriate "C" factor for each crop in the rotation, adding these "C" factors together, and dividing the sum of "C" factors by the number of years in the rotation.

## **Residue Estimation for Planning**

To estimate residue reduction:

- Determine the total amount of residue produced using average crop yield and values provided in Table C-2.

Table C-1 - "C" Factor Yields

<b>"C" Factor Zone: 88A</b> <b>88B</b>		<b>(Ness City, KS, Climate Station 16632)</b> <b>(Norton, KS, Climate Station 16944)</b>
<b>Crop to be Planted</b>	<b>—Yield Level—</b>	
Alfalfa (Established)	( No yield level indicated)	
Corn, Grain	65 BU/AC	
Corn Silage	8 T/AC	
Oats	40 BU/AC	
Sorghum, Grain	65 BU/AC	
Sorghum Silage	6 T/AC	
Sorghum/sudan	6 T/AC	
Soybeans (Drilled)	25 BU/AC	
Soybeans (Row)	25 BU/AC	
Sunflowers	1250 LBS/AC	
Wheat, Winter	40 BU/AC	

  

<b>"C" Factor Zone: 88C</b>		<b>(Concordia, KS, Climate Station 16006)</b>
<b>Crop to be Planted</b>	<b>—Yield Level—</b>	
Alfalfa (Established)	( No yield level indicated)	
Corn, Grain	80 BU/AC	
Corn Silage	8 T/AC	
Oats	40 BU/AC	
Sorghum, Grain	65 BU/AC	
Sorghum Silage	6 T/AC	
Sorghum/sudan	6 T/AC	
Soybeans (Drilled)	30 BU/AC	
Soybeans (Row)	30 BU/AC	
Sunflowers	1800 LBS/AC	
Wheat, Winter	40 BU/AC	

  

<b>"C" Factor Zone: 88D</b>		<b>(Manhattan, KS, Climate Station 16536)</b>
<b>Crop to be Planted</b>	<b>—Yield Level—</b>	
Alfalfa (Established)	( No yield level indicated)	
Corn, Grain	100 BU/AC	
Corn Silage	8 T/AC	
Oats	40 BU/AC	
Sorghum, Grain	65 BU/AC	
Sorghum Silage	6 T/AC	
Sorghum/sudan	6 T/AC	
Soybeans (Drilled)	30 BU/AC	
Soybeans (Row)	30 BU/AC	
Sunflower	1800 LBS/AC	
Wheat, Winter	40 BU/AC	

Each "C" factor area has a corresponding table (Table C-6) and is based upon the listed yield levels. These yield levels represent a medium or average yield for the "C" factor area.

Table C-1 - "C" Factor Yields (continued)

<b>"C" Factor Zone: 89A</b>		<b>(Coldwater, KS, Climate Station 16144)</b>	
<b>Crop to be Planted</b>		<b>—Yield Level—</b>	
Alfalfa (Established)		( No yield level indicated)	
Corn, Grain		65 BU/AC	
Corn Silage		6 T/AC	
Oats		40 BU/AC	
Sorghum, Grain		55 BU/AC	
Sorghum Silage		6 T/AC	
Sorghum/sudan		6 T/AC	
Soybeans (Drilled)		30 BU/AC	
Soybeans (Row)		30 BU/AC	
Sunflowers		1400 LBS/AC	
Wheat, Winter		40 BU/AC	

  

<b>"C" Factor Zone: 89B</b>		<b>(Wellington, KS, Climate Station 16944)</b>	
<b>Crop to be Planted</b>		<b>—Yield Level—</b>	
Alfalfa (Established)		( No yield level indicated)	
Corn, Grain (90 day 30" rows)		65 BU/AC	
Corn Silage (30" rows)		8 T/AC	
Oats		40 BU/AC	
Sorghum, Grain (30" rows)		65 BU/AC	
Sorghum Silage (30" rows)		6 T/AC	
Sorghum/sudan		6 T/AC	
Soybeans (Drilled)		30 BU/AC	
Soybeans (30" rows)		30 BU/AC	
Sunflowers		1400 LBS/AC	
Wheat, Winter		40 BU/AC	

  

<b>"C" Factor Zone: 89C</b>		<b>(Chanute, KS, Climate Station 16012)</b>	
<b>Crop to be Planted</b>		<b>—Yield Level—</b>	
Alfalfa (Established)		( No yield level indicated)	
Corn, Grain (90 day 30" rows)		80 BU/AC	
Corn Silage (30" rows)		20 T/AC	
Oats		40 BU/AC	
Sorghum, Grain (30" rows)		90 BU/AC	
Sorghum Silage (30" rows)		6 T/AC	
Sorghum/sudan		6 T/AC	
Soybeans (Drilled)		40 BU/AC	
Soybeans (30" rows)		40 BU/AC	
Sunflowers		1200 LBS/AC	
Wheat, Winter		40 BU/AC	

Each "C" factor area has a corresponding table (Table C-6) and is based upon the listed yield levels. These yield levels represent a medium or average yield for the "C" factor area.



Table C-1 - "C" Factor Yields (continued)

"C" Factor Zone: 99		(Shenandoah, IA, Climate Station 15006)
Crop to be Planted	—Yield Level—	
Alfalfa (Established)	( No yield level indicated)	
Corn, Grain (90 day 30" rows)	112 BU/AC	
Corn Silage (30" rows)	20 T/AC	
Oats	50 BU/AC	
Sorghum, Grain (30" rows)	100 BU/AC	
Sorghum Silage (30" rows)	6 T/AC	
Sorghum/sudan	6 T/AC	
Soybeans (Drilled)	50 BU/AC	
Soybeans (30" rows)	50 BU/AC	
Sunflowers	1800 LBS/AC	
Wheat, Winter	40 BU/AC	

Each "C" factor area has a corresponding table (Table C-6) and is based upon the listed yield levels. These yield levels represent a medium or average yield for the "C" factor area.

Table C-2 - Residue Produced by Crops

CROP		Estimated Air Dry Residue Produced	Units
Corn		56	lbs/bu grain
Corn Silage Stubble		21	lbs/in/10,000 plants/ac
Grain Sorghum		56	lbs/bu grain
Soybeans		75	lbs/bu grain
Sunflowers		2.2	lbs/lb grain
Oats		64	lbs/bu grain
Winter Wheat		102	lbs/bu grain
Winter Wheat (fall growth)		175-400	lbs/ac
Spring Wheat		78	lbs/bu grain
Rye		84	lbs/bu grain
Rye (fall growth)		175-600	lbs/ac
Millet		80	lbs/bu grain
Dry Edible Beans		2.2	lbs/lb grain
Barley		72	lbs/bu grain
Safflower		1.5	lbs/lb grain
Potatoes		6	lbs/cwt
Sorghum Silage Stubble			
Plant Population:	<58,000 plants/ac	32	lbs/in/10,000 plants/ac
	>58,000 plants/ac	186	lbs/in/10,000 plants/ac
Rape Seed		2	lbs/lb grain
Buckwheat		1.5	lbs/lb grain
Field Peas (dry)		1.2	lbs/lb grain

Table C-3 - Residue Reduction by Type of Activity

Implement	Percent Residue Remaining	
	Nonfragile Percent	Fragile Percent
<u>Drills</u>		
Hoe opener drills.....	50-80	40-60
Semi-deep furrow drill or press drill (7"-12" spacing) .....	70-90	50-80
Deep furrow drill with >12" spacing .....	60-80	50-80
Single disk opener drills .....	85-100	75-85
Double disk opener drills (conventional).....	80-100	60-80
No-till drills and drills with the following attachments <u>in standing stubble</u> :		
Smooth no-till coulters .....	85-95	70-85
Ripple or bubble coulters .....	80-85	65-85
Fluted coulters .....	75-80	60-80
No-till drills and drills with the following attachments <u>in flat residues</u> :		
Smooth no-till coulters .....	65-85	50-70
Ripple or bubble coulters .....	60-75	45-65
Fluted coulters .....	55-70	40-60
Air Seeders: Refer to appropriate field cultivator or chisel plow depending on the type of ground engaging device used.		
Air drills: Refer to corresponding type of drill opener.		
<u>Row Planters</u>		
Conventional planters with:		
Runner openers .....	85-95	80-90
Staggered double disk openers .....	90-95	85-95
Double disk openers .....	85-95	75-85
No-till planters with:		
Smooth coulters .....	85-95	75-90
Ripple coulters .....	75-90	70-85
Fluted coulters .....	65-85	55-80
Strip till planters with:		
2 or 3 Fluted coulters .....	60-80	50-75
Row cleaning devices .....	60-80	50-60
(8"-14" wide bare strip using brushes, spikes furrowing disks, or sweeps)		
Ridge till planter .....	40-60	20-40



Table C-3 - Residue Reduction by Type of Activity (continued)

Implement	Percent Residue Remaining	
	Nonfragile Percent	Fragile Percent
<b>Climatic Effects</b>		
Over winter weathering: *		
Following summer harvest .....	70-90	65-85
Following fall harvest .....	80-95	70-80
<b>Field Cultivators (Including leveling attachments)</b>		
Used as the primary tillage operation:		
Sweeps 12"-20" .....	60-80	55-75
Sweeps or shovels 6"-12" .....	35-75	50-70
Duckfoot points .....	35-60	30-55
Field cultivators as secondary operation following chisel or disk:		
Sweeps 12"-20" .....	80-90	60-75
Sweeps or shovels 6"-12" .....	70-80	50-60
Duckfoot points .....	60-70	35-50
<b>Finishing Tools</b>		
Combination finishing tools with:		
Disks, shanks, and leveling attachments .....	50-70	30-50
Spring teeth and rolling basket .....	70-90	50-70
<b>Harrows:</b>		
Springtooth (coil tine) .....	60-80	50-70
Spike tooth .....	70-90	60-80
Flex-tine tooth .....	75-90	70-85
Roller harrow (cultipacker) .....	60-80	50-70
Packer roller .....	90-95	90-95
<b>Rotary tiller:</b>		
Secondary operation 3" deep .....	40-60	20-40
Primary operation 6" deep .....	15-35	5-15
<b>Rodweeder</b>		
Plain rotary rod .....	80-90	50-60
Rotary rod with semi-chisels or shovels .....	70-80	60-70
<b>Strip Tillage Machines</b>		
Rotary tiller, 12" tilled on 40" rows .....	60-75	50-60
*In northern climates with long periods of snow cover and frozen conditions, weathering may reduce residue levels only slightly while, in warmer climates, weathering losses may reduce residue levels significantly.		

Table C-3 - Residue Reduction by Type of Activity (continued)

Implement	Percent Residue Remaining	
	Nonfragile Percent	Fragile Percent
<u>Row Cultivators (30" and wider)</u>		
Single sweep per row.....	75-90	55-70
Multiple sweeps per row.....	75-85	55-65
Finger wheel cultivator.....	65-75	50-60
Rolling disk cultivator.....	45-55	40-50
Ridge till cultivator.....	20-40	5-25
<u>Unclassified Machines</u>		
Anhydrous applicator.....	75-85	45-70
Anhydrous applicator with closing disks.....	60-75	30-50
Subsurface manure applicator.....	60-80	40-60
Rotary Hoe.....	85-90	80-90
Bedders, listers, & hippers.....	15-30	5-20
Furrow diker.....	85-95	75-85
Mulch treader.....	70-85	60-75
<u>Plows</u>		
Moldboard plow.....	0-10	0-5
Moldboard plow-uphill furrow (Pacific Northwest Region only).....	30-40	---
Disk plow.....	10-20	5-15
<u>Machines which fracture soil</u>		
Paratill/paraplow "V" ripper/subsoiler.....	80-90	75-85
12"-14" deep 20" spacing.....	70-90	60-80
Combination tools:		
Subsoil-chisel.....	50-70	40-50
Disk-subsoiler.....	30-50	10-20
<u>Chisel Plows with</u>		
Sweeps.....	70-85	50-60
Straight chisel spike points.....	40-80	30-60
Twisted points or shovels.....	35-70	20-40
<u>Combination Chisel Plows</u> Coulter chisel plows with:		
Sweeps.....	60-80	40-50
Straight chisel spike points.....	30-60	25-40
Twisted points or shovel.....	25-60	10-30
Disk chisel plows with:		
Sweeps.....	60-70	30-50
Straight chisel spike points.....	30-60	25-40
Twisted points or shovels 20-50 10-30		

**Table C-3 - Residue Reduction by Type of Activity (continued)**

Implement	Percent Residue Remaining	
	Nonfragile Percent	Fragile Percent
<u>Undercutters</u> Stubble-mulch sweep or blade plows with:		
Sweep/"V"-blade >30" wide .....	75-95 .....	60-80
Sweeps 20"-30" wide .....	70-90 .....	50-75
<u>Disk Harrows</u>		
Offset		
Heavy plowing >10" spacing .....	25-50 .....	10-25
Primary cutting >9" spacing .....	30-60 .....	20-40
Finishing 7"-9" spacing .....	40-70 .....	25-40
Tandem		
Heavy plowing >10" spacing .....	25-50 .....	10-25
Primary cutting >9" spacing .....	30-60 .....	20-40
Finishing 7"-9" spacing .....	40-70 .....	25-40
Light tandem disk after harvest, before other tillage .....	70-80 .....	40-50
One-way disk with:		
12-16" blade .....	40-50 .....	20-40
18-30" blades.....	20-40 .....	10-30
Single gang disk .....	50-70 .....	40-60

**TABLE C-4 - RELATIONSHIP OF RESIDUE WEIGHT TO PERCENT  
RESIDUE COVER**

% Cover	Alfalfa, Bromegrass, Rye	Wheat, Oats, Soybeans	Corn	Sorghum	Sunflower
	-----lbs/ac*-----				
5	95	85	135	145	215
10	190	180	275	295	440
15	295	275	430	450	675
20	405	380	585	620	930
25	525	490	755	800	1200
30	650	605	940	990	1485
35	785	730	1135	1195	1795
40	930	865	1345	1420	2130
45	1085	1015	1575	1660	2490
50	1260	1175	1825	1925	2890
55	1450	1355	2100	2220	3325
60	1665	1555	2410	2545	3820
65	1910	1780	2765	2915	4375
70	2190	2040	3170	3345	5015
75	2520	2350	3650	3850	5775
80	2925	2730	4235	4470	6705
85	3450	3215	4990	5270	7905
90	4185	3905	6060	6395	9595

\* Values listed for 30, 60, and 90 percent cover vary slightly from those listed in the RUSLE database due to rounding.



**TABLE C-5 - RESIDUE TYPES**

<u>Nonfragile</u>	<u>Fragile</u>
Alfalfa or legume hay	Canola/rapeseed
Barley*	Dry beans
Buckwheat	Dry peas
Corn	Fall seeded cover crops
Flaxseed	Lentils
Forage Silage	Mustard
Grass Hay	Potatoes
Millet	Safflower
Oats*	Soybeans
Pasture	Sugar Beets
Popcorn	Sunflowers
Rye*	Vegetables
Sorghum	
Triticale*	
Wheat*	

\* If a combine is used with a straw chopper or otherwise cuts straw into small pieces in harvesting small grain, then the residue should be considered as being fragile.

### **Table C-6 - "C" Factor Values for Kansas Crops**

The "C" factor values in the following tables are listed as single year cropping values. The residue levels represent the percent cover that might be found after the planting of the crop being evaluated. Values may be selected for fall mulch tillage systems, spring mulch systems, fall plow (FP), spring plow (SP) and no-till systems (NT).

To determine average "C" values for a crop rotation, add the value for each crop in the rotation and divide by the number of years in the rotation.

Cropping systems are often considered No-till systems if there is no disturbance to the crop residue prior to planting the next crop. If there is any disturbance to the soil surface during the crop rotation i.e., in row cultivation, deep furrow planting, or mechanical tillage select values from the fall or spring mulch tables. The no-till (NT) "C" factor values represent cropping systems that allow for consolidation of the soil surface during the cropping sequence.

Please note the all C-6 tables are being provided. You only need to file the ones pertaining to your county. See Figure K-1 - "C" and "K" Factor Zones in Kansas, which is filed after the K tab. It is on page 2.